

REMARKS/ARGUMENTS

The claims are 1, 2 and 4-6. Independent claim 1 has been amended to more clearly define the invention. Support for the amendments to claim 1 may be found, *inter alia*, in the specification as filed in the first full paragraph at page 4, in the paragraph bridging pages 4-5, in the paragraph bridging pages 6-7, and in claim 2 as filed. No new matter has been added. Reconsideration is expressly requested.

Although the previous rejection of the claims under 35 U.S.C. § 103(a) as being unpatentable over *Tjoa et al.* U.S. Patent No. 3,767,766 in view of *Heisel et al.* U.S. Patent No. 5,628,977; *Keller et al.* U.S. Patent Application Publication No. 2002/0134706; and *Luinstra et al.* GB 2221853A as evidenced by *Mather* U.S. Patent No. 2,365,893 has been withdrawn in view of Applicant's remarks filed October 30, 2009, a new ground of rejection has been made based on newly-cited U.S. Patent No. 4,124,685 to *Tarhan et al.* as the primary reference.

In particular, claims 1, 2, 4 and 5 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 4,124,685 to *Tarhan et al.*, in view of U.S. Patent No. 4,940,081

to *Hyde*, as evidence by *Luinstra et al.* GB 2221853A. Claim 6 was rejected under 35 U.S.C. §103(a) as being unpatentable over *Tarhan et al.*, in view of *Hyde* and further in view of U.S. Patent No. 5,628,977 to *Heisel et al.*

The rejections are respectfully traversed.

As set forth in amended claim 1, Applicant's invention provides a method for isolating hydrogen sulfide from coke oven gas with subsequent recovery of elemental sulfur in a Claus plant, in which method the hydrogen sulfide is removed from the coke oven gas by means of gas scrubbing with an absorption liquid, the charged absorption liquid is regenerated, and hydrogen sulfide that occurs in concentrated form in this connection is passed to the Claus plant. The purified coke oven gas can be passed for further use.

In the Claus plant, a known Claus process is carried out, in which the hydrogen sulfide is combusted with oxygen in a Claus boiler, and reacted, forming elemental sulfur. The elemental sulfur that has been formed is then precipitated by means of cooling, whereby residual contents of hydrogen sulfide (H_2S) and sulfur dioxide (SO_2) are catalytically reacted to form sulfur.

As further recited in Applicant's amended claim 1, the Claus plant is operated with only a single reaction oven operated in a temperature range between 200°C and less than 250°C. The process gas that leaves the reaction oven, after precipitation of the condensed sulfur, is passed back into the coke oven gas, without further processing, to be cleaned, ahead of the gas scrubbing, with a residual content of hydrogen sulfide that was not converted in the reaction oven. A boiler lined with a refractory material, lying horizontally, is used as the Claus boiler, which has a combustion chamber and a catalyst chamber having a catalyst bulk material, which follows horizontally and is delimited on both sides by gas-permeable checker bricks.

It is respectfully submitted that the cited references, whether considered alone or in combination, fail to disclose or suggest a method for isolating hydrogen sulfide from coke oven gas as set forth in Applicant's amended claim 1.

In particular, it is respectfully submitted that the primary reference to *Tarhan et al.*, does not disclose a Claus plant operated with only a single reaction oven, wherein the reaction oven is operated in a temperature range between 200°C and 250°C and wherein the residual gas is passed back, without further processing, into the coke oven gas to be cleaned, as specified in

Applicant's amended claim 1.

Col. 3 lines 25 to 31 of *Tarhan et al.*, which was cited by the Examiner, relates to the background of the invention of *Tarhan et al.* This passage from *Tarhan et al.* points out that the reversible reaction of the Claus process is always run above 250°C:

"...at temperatures above 250°C at which the Claus reactor is run".

In order to overcome the problems associated with the prior art, *Tarhan et al.* provides a method step in which H₂S and SO₂ are passed to a liquid-phase reactor which is operated at a temperature not greater than 160°C (See *Tarhan et al.*, claim 1, feature c).

Figures 1 and 2 of *Tarhan et al.* are not relevant to Applicant's method as recited in amended claim 1 because a Claus boiler is not provided. Moreover, according to *Tarhan et al.*, the embodiment shown in FIGS. 1 and 2 therein is not preferred for the treatment of coke oven gas (See *Tarhan et al.*, col. 7, lines 31 to 34).

Accordingly, the Examiner refers to FIG. 3 and FIG. 5 of *Tarhan et al.*, as disclosing a boiler to form elemental sulfur by burning the hydrogen sulfide with oxygen.

Applicant respectfully submits that the teaching of *Tarhan et al.* must be considered as a whole, including those aspects leading the person skilled in the art away from Applicant's method as recited in amended claim 1. In particular, col. 11, lines 35 to 47 of *Tarhan et al.* provide as follows:

It is for this reason that it has been found necessary when only a single-stage sulfur removal step is used as in FIG. 1, that such a step constitute a liquid phase type process such as the so-called Townsend process. Also, as will be explained in more detail later, it is necessary in the present invention, if a Claus type reactor is to be used, i.e. a reactor in which the reactions occur in the gas phase at more than 160°C, for there to be at least two stages for sulfur recovery. The initial stages can constitute Claus-type burners and/or reactors, but at least the final stage must be a liquid-phase type process such as the Townsend process operation at less than 160°C, and preferably not greater than 140°C or less.

In contrast to the disclosure of *Tarhan et al.* reproduced above, Applicant's inventive method as set forth in amended claim 1 is based on a completely different approach, wherein only a single stage Claus process is provided in a single reactor oven operated in a temperature range between 200°C and 250°C.

FIG. 3 of *Tarhan et al.* cited by the Examiner shows a multi-step Claus plant, wherein hydrogen sulfide is reacted with oxygen in a Claus boiler of a Claus plant, forming elemental sulfur. Reference numeral 179 relates to the first Claus-type reactor in which elemental sulfur and water are formed in accordance with the usual Claus-equilibrium (See *Tarhan et al.*, col. 17, lines 50 to 52). The temperature for this first Claus reaction is not mentioned. Nevertheless, it is pointed out in col. 3, lines 30 to 31 that the Claus reaction in a usual reaction oven is driven by temperatures above 250°C.

According to *Tarhan et al.*, a second reactor 185 is provided, wherein this reactor is run at low temperatures of less than 160°C (See *Tarhan et al.*, col. 17, lines 58 to 62). This two-step Claus process is shown in more detail in FIG. 4 (See *Tarhan et al.*, col. 18, lines 22 to 23). *Tarhan et al.* specifies that hydrogen sulfide is reacted with oxygen in a Claus boiler of a Claus plant 239, wherein the gas is afterwards fed to a thermal reactor 242 and a cooling coil 251 where the gases are cooled sufficiently to condense the sulfur vapor to molten sulfur which is then collected in sulfur collecting tank 253. The cooled gas is reheated in heat exchanger 257 and passed into a catalytic reactor 259.

In contrast to the method as recited in Applicant's amended claim 1, wherein "the process gas that leaves the reaction oven, after precipitation of the condensed sulfur, is passed back, without further processing, into the coke oven gas to be cleaned", the process gas in the method according to Tarhan et al. is not directly passed back, without further processing, into the coke oven gas to be cleaned. Rather, the process gas in Tarhan et al. is cooled down to a very low temperature of not greater than 160°C to allow a second step of the Claus process in a liquid-phase sulfur reactor 83.

Throughout the complete disclosure of Tarhan et al., it is emphasized that this liquid phase sulfur reactor operated at a temperature below 160°C is essential and defines the core of the teaching disclosed (See Tarhan et al. at abstract; claim 1, feature c; claim 8, feature c; col. 5, lines 56 to 62 (summary of the invention); col. 6, lines 32; description of the preferred embodiments). With respect to Applicant's method as set forth in amended claim 1, FIG. 5 of Tarhan et al. does not contain any further information (See Tarhan et al., col. 20, lines 31 to 37).

In addition to failing to disclose features of Applicant's method as recited in claim 1 including a boiler lined with a refractory material, lying horizontally, Tarhan et al. also fails

to disclose or suggest essential features Applicant's amended claim 1, including operating the Claus plant with a single reaction oven, and operating the single reaction oven at a temperature range between 200°C and less than 250°C. In particular, according to *Tarhan et al.*, a two-step Claus process must be a liquid-phase type process operated at less than 160°C (See *Tarhan et al.*, col. 11, lines 43 to 47). Against this background, Applicant's method as set forth in amended claim 1 is based on the finding that only a single reaction oven is sufficient when this reaction oven is operated in a temperature range between 200°C and 250°C and wherein the process gas is passed back without further processing into the coke oven gas to be cleaned.

The secondary references have been considered, but are believe to be no more relevant.

Luinstra et al. discloses a splitting reactor for a Claus system in which a boiler lined in a refractory manner is disposed with a combustion chamber, a catalyst chamber and a chamber on the outflow side lying next to one another. More specifically, *Luinstra et al.* describes a catalyst structure that is referred to as a whole as being rigid and permeable (See *Luinstra et al.* page 3, third full paragraph--a rigid permeable catalyst

structure arranged between the burner and the gas outlet." The rigid permeable catalyst structure according to *Luinstra et al.* can be a layer of particles between two vertical screens (See *Luinstra et al.* at page 5, fifth paragraph).

It is respectfully submitted that one of ordinary skill in the art would not derive from *Luinstra et al.* that the catalyst is configured as a type of catalyst mat or a catalyst insert, wherein the mat or insert is configured to be inserted into the boiler as a complete unit (i.e., a "rigid permeable catalyst structure"). *Luinstra et al.* nowhere discloses or suggests a catalyst chamber delimited on both sides by gas-permeable checker bricks wherein a catalyst bulk material is situated at the interstice formed between the checker bricks, as recited in Applicant's amended independent Claim 1.

Hyde discloses checker bricks used for recovering heat in recuperators (See *Hyde* col. 1, lines 7 to 8). It is emphasized that directly in the Claus boiler itself, a recovery of heat is neither provided nor reasonable as a sufficient temperature is needed to react the hydrogen sulfide with oxygen in the air. Furthermore, there is no disclosure or suggestion to use the checker bricks disclosed by *Hyde* in a Claus boiler. Moreover, it is also believed that the checker bricks disclosed in *Hyde* are

not suitable to delimit a catalyst material as the space between the checker bricks is very large and would not retain catalyst bulk material. Accordingly, the catalyst material would penetrate between the checker bricks or even get into the boiler. In addition, bulk material would accumulate right between the checker bricks and could not be removed. In other words, the free spaces defined between the checker bricks would be much too large.

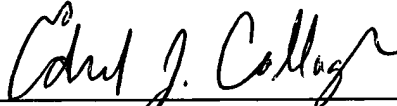
Hyde also teaches the stacking of several layers of checker bricks (see FIG. 4), wherein the checker bricks are provided to define *vertical flues* (See Hyde col. 4, lines 61 to 62). In contrast to this teaching, Applicant's method as recited in amended claim 1 provides boiler lines with refractory material, laying horizontally. Accordingly, the gas flows in a horizontal, and not a vertical direction. Against this background the person skilled in the art would not consider combining the teaching of Hyde with Luinstra et al. discussed above.

Thus, it is respectfully submitted that one skilled in the art would have no reason to make the combination suggested by the Examiner, and even if one were to combine the references as hypothetically proposed, one would still not achieve Applicant's method as recited in amended claim 1.

In summary, claim 1 has been amended. In view of the foregoing, it is respectfully submitted that claim 1, together with claims 2 and 4-6 which depend thereon, are patentable over the cited references.

In view of the foregoing, it is respectfully requested that the claims be allowed and that this application be passed to issue.

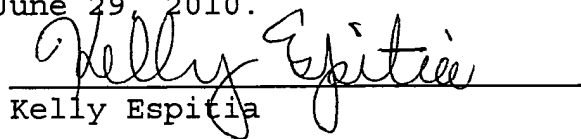
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